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agricultural research

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An Ancient Prize

The apple has long been savored and celebrated by mankind. Some 4,000 years ago apple seeds were carried from their southwestern Asian homeland by the various migrations that swept across Europe. In time, the apple was established over most of the continent. For example, archeologists working the neolithic lake dwellings of Switzerland found the charred remains of puny apples, mute testimony that the inhabitants not only stored them for winter food, but also preserved them by drying in the sun. Centuries later, Roman legions introduced the art of budding and grafting to the British isles. The improved local stock soon ranked as the king of fruits and gave rise to a folklore rich in praise of apples.

When the English colonists crossed the Atlantic their love of apples came with them. Pilgrims planted apples and soon harvested good crops. Later, as covered wagons lumbered westward, their cargoes included precious "scion wood" for grafting the live buds of a desired variety to a seedling or tree.

The westward spread of apples was greatly aided by John Chapman, the "Johnny Appleseed" of history and legend. This gentle eccentric, often barefooted and clad in burlap even in cold weather, had a passion for planting apples. A familiar and beloved figure in the frontier country, he dipped into his bags of seeds and set out small apple nurseries in forest openings during his wanderings over some 10,000 square miles of Ohio, Indiana, and Illinois. For 40 years Chapman tended his far-flung nurseries, making the saplings available to local settlers, and contributing to the country's growth.

Many of the varieties that Chapman planted in "the Ohio Country"—Roxbury Russet, Black Spitzenburg, and Gillyflower—bear names that evoke nostalgia. For generations they were among the favorites of our forebears, flourishing during the era of small farms. Victims of the demands of the modern age, these varieties are gradually disappearing, only occasionally to be found on old farmsteads or in a few collectors' orchards.

Agricultural science, especially in the past 60 years, has brought the apple a long way from the puny specimens known to the Swiss lake dwellers. Today's trees must give high yields of apples that handle, store, and ship well. Thirteen "super" varieties comprise about 90 percent of all U.S. production, providing a wealth of juicy and crisp apples admirably adapted to the needs of mass marketing and distribution. Future needs will undoubtedly change, but science will provide an abundance of apples, mankind's ancient and cosmopolitan prize.

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COVER: The damage that ozone air pollution inflicts is an affront to nature. Research on petunias, however, has shown that this damage can now be greatly reduced. See story beginning on p. 3 (0372K361-34).

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Saving the green

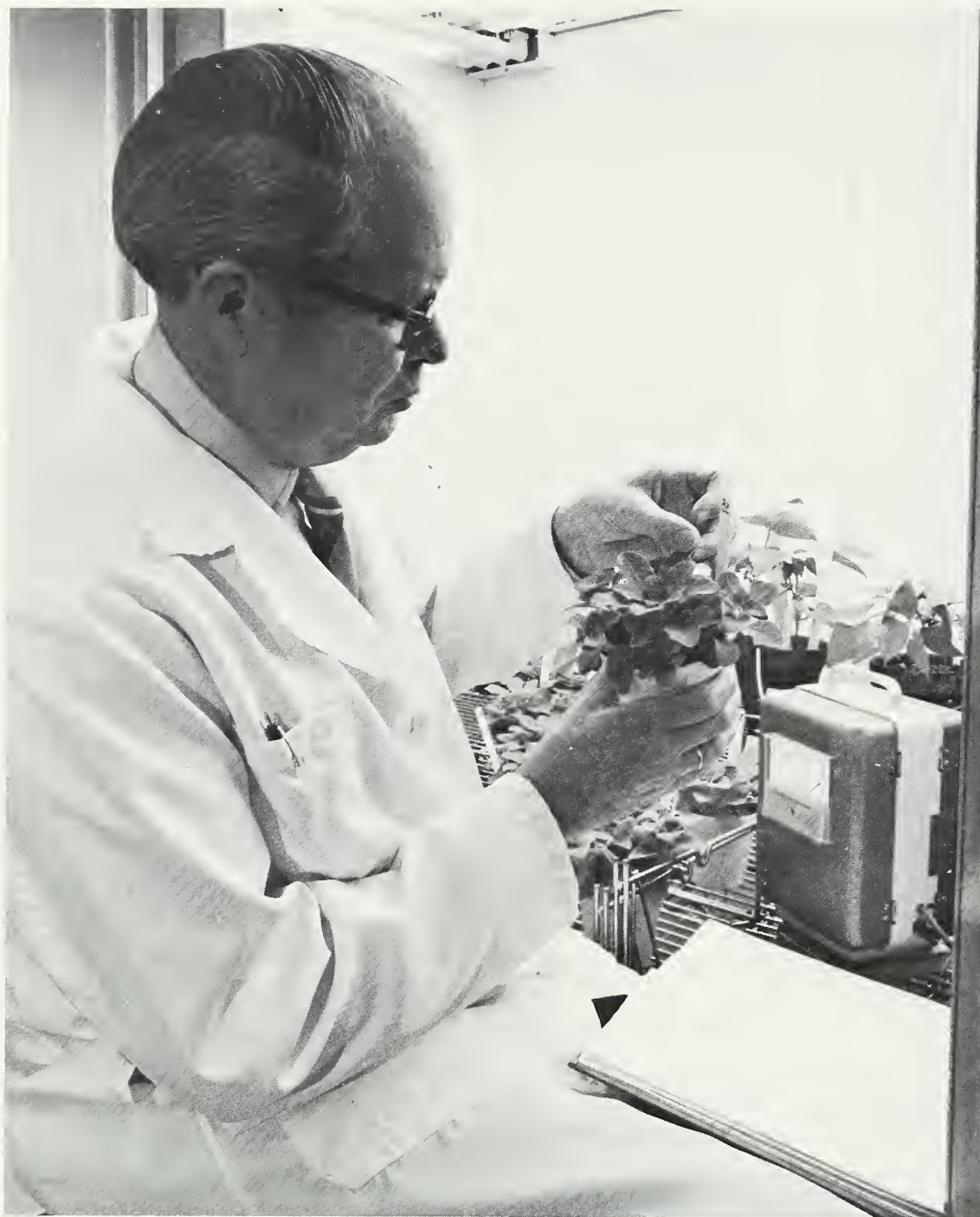
THE UNSIGHTLY DAMAGE that ozone air pollution inflicts on the most popular and colorful garden annual, the petunia, can now be greatly reduced. The benefactor is the commonly used growth retardant SADH (succinic acid 2,2-dimethyl hydrazide) which effectively reduces the plant's sensitivity to this common pollutant.

Petunias, long recognized as one of the most sensitive plant species to air pollution damage by ozone, are sometimes used to detect and to monitor the amount of pollution in urban areas. As the primary toxicant in photochemical smog and a byproduct of the internal combustion engine, ozone is the most damaging air pollutant affecting vegetation in this country.

ARS horticulturist Henry M. Cathey and plant pathologist Howard E. Heggestad at Beltsville, Md., evaluated the effects of varying ozone levels on 65 petunia varieties and grouped them ac-

Below : *Sulfur dioxide, the major air pollutant on a worldwide scale, destroys the chlorophyll-bearing cells of leaves. The affected leaves develop white areas in between the veins. Leaf on the right is a healthy one (0372K361-28).*





Above: Dr. Howard E. Heggstad, research plant pathologist and leader of the Plant Air Pollution Laboratory, Beltsville, Md., examines petunias that have been fumigated with an air pollutant in a controlled environment chamber. The meter on the floor of the chamber is used to monitor the level of the toxic gases in the air-tight chamber (0372K362-26). Above right: Dr. Henry M. Cathey (left), research horticulturist and leader of Ornamental Investigations, Beltsville, Md., and Dr. Heggstad examine Pink Cascade petunia plants grown on 16 hour days at night temperatures of 70° and 50° F. Low temperature (50° F.) modifies the plant's sensitivity to air pollution and reduces visual injury to the foliage (0372W365-11).



cording to severity of damage. They next applied different growth-regulating chemicals to the petunia plants before exposing them to ozone, then determined the chemicals' effects in altering the plants' sensitivities to ozone.

The scientists found that chemicals applied to the soil are much less effective than foliar sprays, and that SADH is outstanding in protecting the plants—except to doses of ozone more massive than any yet found in the most polluted urban areas. Adding L. ascorbic acid (vitamin C) along with a wax coating to the spray solution increases the protection. The wax simply adds another protective coating over the plant's natural coating. Vitamin C's role in protection is not yet understood. However, twice as much SADH is necessary for best protection of the plant than is required for its use as a growth retardant in producing compact plants in nurseries. Also, plants sprayed for the greatest ozone protection are no shorter than those sprayed for compact growth.

Of the 65 varieties tested, five fall into the most tolerant group; five into



Left: Dr. Cathey and Dr. Heggstad discuss the air pollution damage on the plant Dr. Heggstad is holding. The visual injury is evident on most of the foliage. The petunia plant Dr. Cathey is holding was protected against air pollution injury through the use of a growth modifying chemical (0372K361-22). Above: These plants were grown in controlled rooms to prepare them for air pollution studies. Day length—left to right—24, 20, 16, 12, and 8 hours. Temperature front to back, 50°, 60°, and 70° F. The greatest visual damage occurred on plants grown on 16 hour photoperiods at a night temperature of 70° F. (0372K364-15).

the most sensitive. Most tolerant are Capri, Fire Gleam, Pink Joy, Popeye, and Purple Plum; most sensitive are Fiesta, Harmony, Pink Paradise, Snow Magic, and White Joy. The 55 remaining fall into four intermediate categories. This is the first time a large number of petunia varieties have been evaluated and rated for tolerance and sensitivity to ozone.

A major contribution of the study, according to Dr. Cathey and Dr. Heggstad, lies in revealing the petunia's wide range of genetic sensitivity to ozone pollution, thereby offering hope that additional ozone tolerant varieties can be developed by breeding.

A separate but related study conducted by the scientists on the relationship of ozone damage to daylength and temperature modification of growth showed that petunias sustained more damage when grown at higher temperatures and at an intermediate daylength. At a night temperature of 50° F. there is less damage than at 60°, and less damage at 60° than at 70°. Oddly, more damage occurs at daylengths of 12 and 16 hours than occurs at 8, 20, and 24

hours. Intermediate daylengths and warmer night temperatures are generally found during the spring growing season.

The effects of air pollution on the structure and physiology of plants is not yet well understood. However, after ozone enters the minute openings, called stomates, in the leaves, it apparently disrupts the membrane structure of some leaf cells. This causes the cell to lose water and die. If many cells are affected, entire leaves or even the entire plant may collapse and die.

The scientists assume that SADH, by reducing the size of the stomatal openings, or sometimes even causing them to close, restricts entrance of ozone into the leaves. The chemical also decreases the size of cells and increases the thickness of cell walls. Thicker cell walls might help reduce water loss from cells, which seems to be a primary response to pollution. However, only detailed physiological studies will clarify the mechanisms involved in pollution damage to plants. Armed with this knowledge, man should be better able to protect his life-sustaining plants. □

TCDD residues disappear

A TOXIC CONTAMINANT that once appeared in the pesticide, 2,4,5-T, was not detected in recent studies of soil samples and bald eagle tissue and so does not appear to be a residual threat to wildlife.

The contaminant, 2,4,7,8-tetrachlorodibenzo-p-dioxin (TCDD), can be formed during manufacture of some chlorinated phenols if temperatures

above safe limits are used (AGR. RES., October 1971, p. 8). Prior to 1969, traces of TCDD were found in some samples of the herbicide 2,4,5-T.

While regulations and industry quality control have been established to eliminate the threat of TCDD contamination in pesticides, chemist Edwin A. Woolson and technician Peter D. J. Ensor of ARS investigated the possibility

that TCDD residues from old, extremely heavy 2,4,5-T applications might still pose a threat to wildlife.

The research was done in cooperation with William L. Reichel, chemist with the U.S. Department of Interior, Patuxent Wildlife Research Center, Laurel, Md., and Alvin L. Young, formerly a project scientist with the U.S. Air Force, Eglin Air Force Base, Fla.

They analyzed soil samples from experimental plots of Lakeland sand in Florida that had received massive doses of 2,4,5-T by aerial application during an 8-year period from 1962 to 1970, a period during which TCDD traces of up to 40 parts per million (ppm) had been detected in commercial 2,4,5-T. Analysis for TCDD residues began in 1970.

A total of 947 pounds of active 2,4,5-T per acre was applied over a 3-year period to the Lakeland sand. This is a massive dose when compared to normal application rates for brush control on grazing land of 2 pounds per acre, or 6 pounds in a 3-year span. Using analysis techniques capable of detecting less than 1 ppm of TCDD, the scientists found no residues in 3-foot core samples.

No TCDD residues were found at the lower limit of detection—0.05 ppm in eagle tissue. Bald eagle tissue extracts were obtained from 19 carcasses collected in 15 States as widely separated as Alaska, Maine, Florida, and Missouri. Eagles were used as representatives of the top of a food chain.

The scientists suggest several reasons why no TCDD was detected in either the soil or eagle tissue samples. For example, dissipation from the soil may have resulted from microbial degradations, photodecomposition, volatility, and/or wind erosion. In the case of the eagle tissue samples, the results suggest that TCDD residues from past pesticide applications were not available to enter the food chain.

These results, combined with the tolerance limit of 0.1 ppm TCDD assures freedom from health hazards due to TCDD contamination. □

Right: *Environmentally secure, the Dillon Beach facility lies between rolling hills and the sea. Dr. William Dungan, veterinary pathologist with Nicholas Turkey Breeding Farms, Inc., indicates the broad expanse that helps keep the turkeys free of Salmonella (0672X861-14).*

Below: *Tight security requires visitors to don disinfected boots and coveralls (0672X861-5).*



FIGHTING SALMONELLAE at DILLON BEACH



Above: *In the controlled atmosphere of Dillon Beach breeding pens, eggs are collected and individually marked with vital genetic information (0672X862-18).*

CONTROL of the turkey industry's most important bacterial diseases, the goal of a new cooperative project, could save turkey breeders millions of dollars annually and further assure the safety of our food supply.

Paratyphoid infections caused by enterobacteria of the genus *Salmonella* are extremely costly to the turkey breeder. Alone and in combination with other pathogenic micro-organisms, *Salmonellae* cause a wide range of diseases that result in death or reduced growth rate and reproductive efficiency.

Salmonella also poses a potential threat to man. If meat or eggs carrying the organism are not sufficiently cooked before eating, they may produce mild to severe intestinal upsets. Most susceptible to infections are the old and the young. *Salmonellae*, however, are

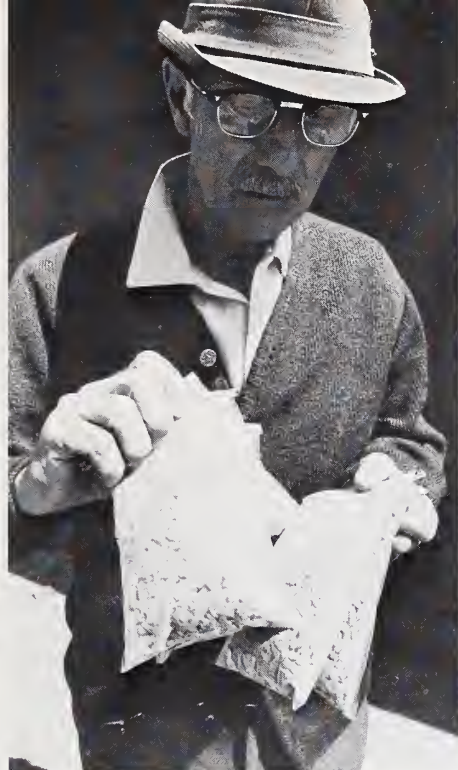
Below: After the eggs are marked, they are examined and data is recorded on weight, size, color, and conformation. Only one egg in five meets strict breeding criteria established for project flocks; these are fumigated and transferred to incubation rooms (0672X857-12). **Near right:** Postmortem examination for evidence of disease is performed routinely by Dr. Richard Hull, pathologist at the California State Livestock and Poultry Laboratory, Petaluma (0672X858-24). **Center right:** Feed, a possible source of contamination, is under constant surveillance by cooperating researchers. Here, Dr. Dungan holds bags of feed samples to be shipped to the Petaluma laboratory for analysis (0672X861-20). **Far right:** These turkeys—raised under commercial conditions free of salmonella—will become the grandparents of turkeys made available to commercial breeders (0672X861-18). **Below right:** Antiseptic integrity is all important at Dillon Beach. Here, a technician disinfects a rearing house prior to its receiving a new brood of chicks (0672X857-7).



quickly killed by heat during cooking.

Demonstrating concern for our Nation's turkey industry and for man's food supply, cooperating scientists and agricultural leaders began a disease control project at Dillon Beach, Calif. The purposes of the project are to raise turkeys under commercial conditions free of *Salmonella*, *Arizona hinshawii*, and *Mycoplasma*; to extend this disease-free status to multiplier flocks; and eventually to extend the concept to include other diseases. The project has been extremely successful in keeping flocks free of *Salmonella*. These flocks will be the grandparents of turkeys made available to commercial breeders.

Cooperating in the project are ARS



veterinary scientists, a large Pacific coast turkey breeder, the California State Department of Agriculture, the University of California, and USDA's Animal and Plant Health Inspection Service.

The Dillon Beach area was chosen because it is isolated and because no turkeys that might introduce *Salmonella* to the area had been raised there. Moreover, construction of houses with semicontrolled environments permits continued confinement rearing and easy surveillance of all birds and prevents contact with wildlife.

Hatching eggs, rather than live birds, were brought to Dillon Beach from hatcheries that were free of *Salmonella*

organisms. From that time on, except for the introduction of a genetically superior line of turkeys, all turkey replacements, approximately 150,000, were raised at Dillon Beach.

There, to maintain the disease-free environment, the scientists constantly test all possible sources of contamination such as turkeys, feed, and water. In the past 2 years, some 80,000 hatching eggs, 40,000 poults, 12,000 selected primary breeders, and about 2,000 tons of feed have been under routine surveillance. Only one isolate of *Salmonella* has been taken from a sample of feed.

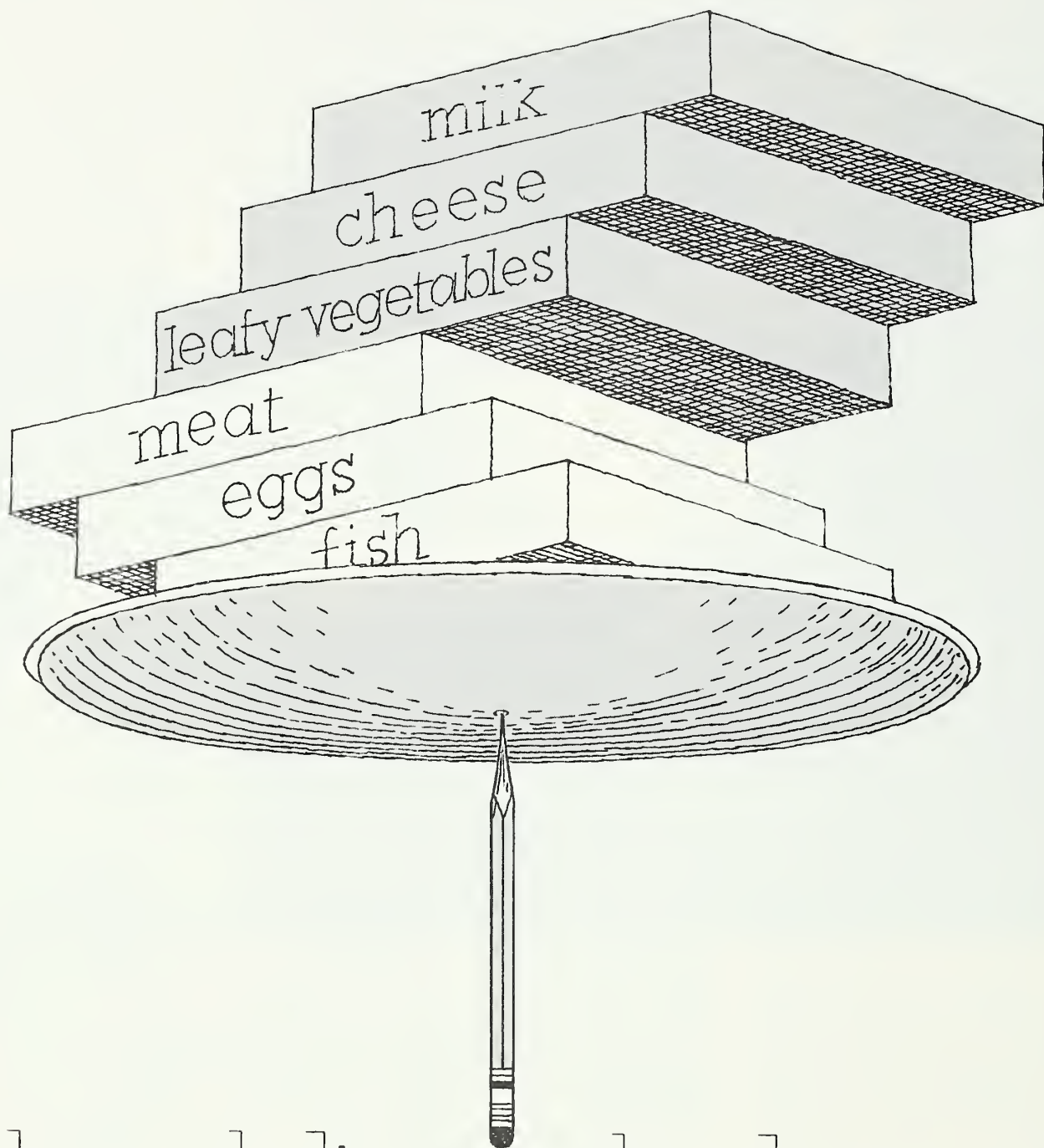
The project is being expanded to include study of progeny of the breeding flock on several farms. □

Salmonellae, of which there are 1,500 types, are widespread in the environment and consequently difficult to control. Infection of turkey breeding stock may come from many different sources—such as rats, birds, and skunks; feed containing fish, or animal byproducts; and man, who may inadvertently carry the organisms from place to place.

Through the National Poultry Improvement Plans (NPIP), administered by ARS in cooperation with the States, excellent progress has been made toward controlling *S. pullorum* and *S. gallinarum* in turkeys. All supply flocks for participating hatcheries are tested for these *Salmonellae*, and during 3 of the past 6 years, no reactors have been found. The control of *S. typhimurium* and *M. gallisepticum* is also included under the plan, but practicable serologic tests have not yet been developed for other *Salmonellae*, including *S. Derby*, *S. heidelberg*, and *S. infantis*.

Toxicity of *Salmonella* is due to the endotoxins produced within the organism and released when it dies. It may cause high mortality in poults and infect hatching eggs, killing the embryos. The bacteria is passed to the eggs in several ways—by infection of the egg before the shell is formed, by contamination of the shell as the egg leaves the turkey's body, or by environmental contamination such as dirty nesting areas or litter.

Though older birds usually show no clinical signs of the disease, they may suffer from reduced disease resistance and lowered growth rate and feed efficiency. They may also become carriers and pass the infection on to other live birds or contaminate killed birds in slaughter plants.



the delicate balance

ONE INTERESTING ASPECT of human nutrition involves the interplay of nutrients. For example, calcium, which is present in the body in larger amounts than any other mineral and is one of the nutrients most often in short supply in the American diet, must have the help of vitamin D before it can be absorbed from the gastrointestinal tract into the bloodstream where it is carried to different parts of the body.

ARS-sponsored research indicates that calcium metabolism is also affected by the amount of protein consumed. According to studies by a team of University of Wisconsin scientists headed by Dr. Hellen M. Linkswiler, the amount of protein in the diet may be as important to the body's calcium needs as the amount of calcium ingested. These studies indicate that high intakes of protein increase the requirement for this mineral, which is highly important to the structure of bones and teeth and essential for blood clotting, muscle tone, and nerve function. Too much protein can increase the need for calcium to a point where the body is in a negative calcium balance—the food eaten is not supplying enough to meet bodily needs. Although previous studies have shown that a high protein intake increases calcium absorption, the counteracting effect of calcium lost in the urine was not considered.

When the body receives a generous amount of calcium in the diet, part of it is stored in the bones and may be withdrawn during times of stress when increased amounts are needed. Calcium that is not absorbed by the body is eliminated in the feces. Calcium used in body functions and not built back into the bones is excreted in the urine. Results of the first Wisconsin study show that the amount of calcium lost from the body through the urine is dramatically affected by protein intake.

In this study six young men, 18–20 years of age, were fed diets having a

calcium content of 1.4 grams with: (1) a low, or (2) a high-protein content of 48 or 135–140 grams per day for a period of 15 days each. The 15-day period in each case followed a 10-day experimental period during which the subjects consumed the low-protein diet. This allowed time to adapt to the level of calcium to be ingested later and permitted the subjects to begin each part of the study from the same level of protein intake. The two parts of the study were separated by a 10-day period during which the subjects consumed self-selected diets.

The experimental diets were composed of ground beef, milk, potatoes, vegetables, fruits, cereals, bread containing added wheat starch, a fat mixture, and carbonated beverages. The high-protein diet contained the same foods as the low, except for the increased protein and the reductions in sugar, starch, and fat necessary to compensate for calories provided by the protein added in the form of casein, lactalbumin, wheat gluten, and gelatin.

Subjects who received the high-protein diet excreted increasing amounts of calcium in the urine. In some cases bodily needs were not met and there was a negative calcium balance when the protein intake reached 135 grams a day. (The ARS Food Consumption Survey of 1965–66 showed that a daily intake of 135 grams is not uncommon for boys of 18–19 years.) Although decreased fecal calcium indicated that subjects on the high-protein diet absorbed more of the dietary calcium, the net result was a decrease in calcium retention. Positive balance with some storage of calcium was maintained with a low-protein intake of 45 grams.

Findings for the second study showed a similar effect of protein on calcium retention. Nine young men ranging in age from 19 to 21 years were fed different levels of protein during three 15-day experimental periods following a

10-day stabilization period during which all subjects were fed the high-protein diet. Calcium intake was varied at 400, 800, and 1,000 milligrams daily while the protein intake was set at 47, 95, and 142 grams per day. Effects of the protetin ingested with these amounts of calcium were similar to those recorded for the first study. This has added significance since 800 milligrams calcium is the Recommended Dietary Allowance proposed by the Food and Nutrition Board of the National Academy of Sciences-National Research Council.

In this study increases in protein intake had a significant effect on both fecal and urinary calcium. Every subject excreted less calcium in the urine when partaking of the low-protein diet compared to the medium, and less when fed the medium protein diet compared to the high. For one subject designated by the scientists as representative of the group, the effect of protein intake on the amount of calcium excreted through the urine was immediate, usually occurring within 24 hours of the change in protein level. With the 800 milligram daily intake of calcium all subjects lost substantial amounts of calcium when fed 142 grams protein, but retained calcium when they consumed 47 or 95 grams. These increases in urinary calcium following increased protein intake were not accompanied by comparable increases in calcium absorption.

Results of the Wisconsin studies indicate that with the continued increase in protein consumption in the United States, more research is needed to examine the relationship between protein intake and calcium retention. The possible effect of a high-protein diet on the development of certain bone diseases should be considered. Some reducing diets include protein intakes that proved detrimental to the adult male subjects in the Wisconsin studies. □

RADIOLOGY_

diagnostic tool for seeds

JUST as an internist relies on not one, but a battery of tests to diagnose his patient, so do seed technologists to evaluate seed quality. One of these—X-ray analysis—is not new, but recent ARS-sponsored Indian work in this field has upgraded the test.

ARS cooperating scientist Dr. Lowell W. Woodstock says the X-ray photographic method for analyzing seed quality is based on the principle that

different parts of a seed, such as endosperm and embryo, absorb low-energy X-rays to a different extent. As a result, various parts of any given seed can be differentiated in an X-ray photograph.

"In the Indian research," he says, "the extensive data obtained about many crop seeds show that simple contact radiography and X-ray contrast have excellent potential for quick testing of anatomical and physiological aspects of seed quality." Anatomical aspects are embryo development, mechanical and weather damage, and insect damage; physiological components refer to viability, or germination potential.

The Indian scientists standardized X-ray evaluation techniques for the seeds of some 70 species of crop plants, including cereals, citrus, vegetables, oilseeds, fiber, pulses, plantation (coffee, tea, rubber), and of forest trees.

For best results with simple contact radiography, the scientists X-rayed at a distance of 25 centimeters, using 15,000 volts and an exposure time of 3 seconds. To accomplish this, the Indians modified the electrical circuit of their diagnostic unit to lower the voltage range for improved absorption; most medical X-ray units have a range of 30,000 to 90,000 volts. One of the advantages of X-ray analysis over other seed testing techniques is that, with simple contact radiography under precise conditions, *no damage* occurs to the seeds. This permits the subsequent planting of seeds for germination tests and direct comparison of X-ray and germination test data.

For X-ray contrast, in which seeds are first soaked in a salt solution to afford comparison of areas and degree of penetration, tables for optimum soaking time and concentration of barium salts had to be worked out for each species. With the contrast technique, which was used for physiological evaluation, the "no damage" benefit was reduced because the most commonly used contrast agent, barium chloride, is somewhat toxic. The degree of toxicity, the scientists found, varies with kind of seed.

Also, penetration of seeds by barium chloride is sometimes erratic. To remedy this, the Indians experimented with several other organic contrast agents. One of them, meglumine diatrizoate injection (MDI), was much less toxic than barium chloride; also, specifically with pulses, MDI showed more efficient penetration.

Some of the important results of the Indian work have shown that X-ray analysis can be efficiently used to:

- aid in the isolation of viable hybrid seeds in breeding programs;
- detect polyembryonic seeds in citrus and mango, enabling horticulturists to isolate them undamaged;
- estimate the frequency of monogerm seeds in beets as a tool in grading these desirable seeds and,
- efficiently detect insect damage in seed for wide applicability in plant quarantine procedures.

The Indians also observed that seed size does not necessarily indicate embryo size. Therefore, the discarding of seed lots on the basis of seed size alone in certain crops—tea, for example—may not be justified.

Tea also proved to be one of the few seeds in which fungal pathogens could be detected by X-ray observation of fungal mycelial mats. In most kinds of seed, X-ray detection of fungal pathogens is difficult because attempts to create a contrast between host tissues and pathogen have been unsuccessful.

Detection of seed-borne pathogens is one of several areas in which additional research is needed. The Indians point out that techniques such as X-ray microscopy need to be perfected, so that radiographs of very small seeds could be enlarged and accurately analyzed. Also, the Indians suggest that extensive work with known frequency of haploids and aneuploids might give clues for the detection of these undesirable seeds by the radiographic method. Directed by Dr. M. S. Swaminathan, principal investigator, these Public Law 480 studies were conducted at the Indian Agricultural Research Institute, New Delhi. □

SEVERE mosquito infestations that originate in poorly drained fields may be curbed under some conditions by drilling through impermeable soil to permeable layers in small areas chronically affected by poor drainage.

Such drainage should be a useful tool for mosquito-control agencies or individuals faced with small problem areas in fields that are otherwise well-contoured and watered, in acreages where alternate cropping systems and good cultural practices are nonfeasible, and in a variety of other situations, such as grader ditches, where the seepage of irrigation water creates temporary mosquito habitats.

In some areas calcium, silica, and iron react with other soil constituents to produce hardpan—a layer impermeable to water. Also, some fields are composed primarily of sandy loam but contain areas of heavy clay that are but slightly permeable to water. Water may lie on the soil surface of hardpan or the heavy clay areas for 5 days or longer. Forage production and quality diminishes, and mosquito infestations build up in heavy numbers to plague both man and livestock.

At Fresno, Calif., ARS entomologist L. Fred Lewis is working on methods for the control of *Aedes nigromaculus*, a mosquito that has adapted to irrigated farming. Unlike many inland mosquitoes, *A. nigromaculus* does not deposit its eggs in water but deposits them on the ground like coastal floodwater mosquitoes. When the ground is under water more than about a week, the eggs hatch and adult mosquitoes emerge.

In some parts of California, and elsewhere, available insecticides are no longer effective in controlling this kind of mosquito. Even if effective new chemicals are found, the mosquitoes are likely to become resistant to them.

In cooperation with Fresno State College, Fresno, Calif., Mr. Lewis and technician Darrell M. Christenson studied hardpan conditions in the col-

lege's fields and developed a vertical drainage system that could be widely used as a technique for mosquito control. It may also be modified for greater forage production and as an adjunct to existing water management practices for irrigated fields.

Using a mechanical auger equipped with a special boring head capable of penetrating hardpan, Mr. Lewis bored holes in the lowest part of a field underlain by hardpan. In some instances, shallow ditches leading to the hole were dug. Mr. Lewis and Mr. Christenson found in preliminary experiments that a 9- to 11-foot-deep hole with a diameter of 4, 6, or 9 inches provided adequate drainage. Tests showed that this depth of hole generally was necessary to reach a pervious sandy layer.

The hole was then filled with coarse gravel and topped with about 4 inches of loam soil. Several trials with this system showed that water drained within 24 hours in experimental plots that previously held water on the surface for about 1 week. If the technique could be generally adapted for use in hardpan areas, vertical drainage would provide a drastic and lasting effect on mosquito breeding and infestations.

The experimental drainage system will be evaluated in future tests to determine that sealing or clogging does not occur—a problem that might require additional drilling. Drainage problems occurring in large areas might be handled by other means involving complete soil and water conservation studies. □

Soil drilling controls mosquitoes



Left: Mechanical auger is lined up by technician for experimental drainage tests. In some irrigated pastures and other fields affected by underlying layers of heavy clay or hardpan, drainage may be inadequate to prevent mosquito buildups. Drilling through impermeable soil could help solve such problems occurring in small areas (PN-2802).

Right: A new treatment for cotton fabrics makes them virtually flame resistant, wrinkle resistant, and durable (BN-39348).

Improved flame resistance for cotton

BEGINNING July 29, 1973, children's sleepwear fabrics, such as cotton, will have to meet new Federal standards for fire retardancy as laid down by the Flammable Fabrics Act.

Although there are a number of flame retardants available for cotton, most are either prohibitively expensive or give a yellow cast to the fabric. A major concern of the textile industry has been to find a retardant that provides the needed flame protection but still allows the cotton to retain its other desirable qualities.

Chemists at the Southern regional research laboratory in New Orleans have developed an improved chemical treatment that seems to be the best answer to the problem. This new treatment not only allows the cotton to meet the Federal requirements for fire retardancy, but also adds a moderate degree of wrinkle resistance, does not give the fabric the yellow cast imparted by most other retardants, and is

the cheapest of the durable treatments.

The chemists who developed the treatment, Darrell J. Donaldson, George L. Drake, Jr., Floyd L. Normand, and Wilson A. Reeves, had earlier created flame retardant formulations by reacting tetrakis-(hydroxymethyl)phosphonium chloride (THPC) with cyanamide and THPC with urea. Both resulted in good finishes, but neither was suitable for use in lightweight fabrics as they produced a high degree of stiffness.

To improve the formulation they added trimethylolmethylglycoluril (TMMGU) and dibasic sodium phosphate to the basic THPC-urea formulation. A minimum of 2 percent TMMGU proved necessary while 5 percent resulted in the harsh, stiff fabrics that the scientists were trying to avoid. Three percent of both TMMGU and the phosphate appear to work best.

Fabrics were treated with the finish by wetting the fabric in the treating

solution and squeezing out the excess to give a 90-percent wet pickup. The fabrics are then dried at 85° C. and cured at 160° C. for 1½ to 2 minutes. All the samples of the treated fabrics passed the vertical flame test after 50 laundry cycles and a 3-hour soap-soda boil. The fabrics also had moderate to good wrinkle resistance and retained 60 percent of their original tearing strength and 115 percent of their breaking strength.

According to Mr. Drake, this new treatment is "the one process suitable for mills with permanent press finishing systems, without having them add special equipment." Another advantage, he added, was that the chemical cost was the most inexpensive of all the durable retardants.

This new treatment allows textile manufacturers to produce the lightweight cotton fabrics with both the safety and the utility that today's consumers are demanding. □



AGRISEARCH NOTES

Heifers gain on MGA

FEEDLOT HEIFERS gain faster and more efficiently if fed an estrous suppressant. Estrous heifers attempting to mount one another is a main reason for their less efficient weight gain as compared to steers under the same management.

ARS nutritionist Hudson A. Glimp and geneticist Larry V. Cundiff conducted studies at the U.S. Meat Animal Research Center, Clay Center, Nebr., that showed the addition of melengestrol acetate (MGA) to the diets of heifers improved their feedlot performance by 7 to 10 percent. MGA is a synthetic hormone which suppresses heat.

Five hundred and forty-seven yearlings and 2-year-old Hereford and Angus heifers were used to compare three treatments: (1) An ear implant containing 120 milligrams (mg.) testosterone and 24 mg. diethylstilbestrol (DES); (2) an ear implant containing 120 mg. testosterone and 24 mg. DES plus 0.40 mg. MGA fed daily, and (3) 0.04 mg. MGA fed daily.

Results showed that heifers fed only the MGA had a significantly faster rate of gain than those on the other two treatments. Cattle gained 3.10, 3.06, and 3.20 pounds per day for treatments 1, 2, and 3, respectively. Heifers receiving the testosterone-DES implant and MGA dressed slightly higher (60.60 percent) than did those receiving only MGA (59.75 percent). Differences in carcass traits did not show consistent treatment effects.

Feeding MGA to heifers is a practical and inexpensive way of increas-

ing efficiency when feeding large numbers of heifers penned together. However, Dr. Glimp does not recommend this method when feeding heifers penned with steers since they and feeds would have to be separated. MGA should not be given to steers.

MC cuts crossbreeding time

MITOCHONDRIAL complementation (MC), often considered the breeding tool of tomorrow, holds some promise for breeding sugar beets.

MC is a rapid test tube technique recently developed for testing plant crosses for hybrid vigor (AGR. RES., March 1971, p. 3). It has proved very effective in grains, particularly barley.

The technique basically consists of extracting the microscopic respiratory bodies, called mitochondria, from the cells of chosen parental combinations and mechanically mixing them together in test tubes. If crosses between two parents will produce vigorous hybrid offspring, the respiratory efficiency of the mixture in the test tube shows an increase over that of either parent, or an efficiency greater than that of other not-so-vigorous offspring.

It is known that hybrid vigor in sugar beets, as in other crops, results from crossing certain inbred lines. In such a breeding program, however, 2 or more years of field trials are required to make the necessary crosses and to test the resulting offspring. In addition, both time and space usually limit the number of crosses that can be tested. It was not known until now,

however, that mitochondrial complementation might be valid for sugar beets.

Motivated by the possibility of a less time-consuming method of testing crosses for hybrid vigor, ARS geneticists Devon L. Doney and J. Clair Theurer and plant physiologist Roger E. Wyse, Logan, Utah, evaluated the MC technique on sugar beet roots in both inbred and hybrid combinations. They used sugar beets of known vigor and parentage.

The scientists found a definite positive correlation between the plants with hybrid vigor and mitochondrial respiratory efficiencies, although the increased efficiencies in the test tubes were not as dramatic as those found in grains, for which the technique was originally developed. Dr. Doney speculates that perhaps the lack of comparable dramatic results might be due to less genetic homogeneity in sugar beet inbred lines when compared to inbred grains. Or perhaps it could be due to the fact that only mature roots were tested, rather than young seedlings. However, despite the lack of dramatic respiratory differences, the results were positive.

Dr. Doney says sugar beet roots offer some advantages in testing because of the large amount of plant material and freedom from substances that are detrimental to mitochondrial respiration.

As further experimentation and refinement of techniques continue, the scientists believe that MC breeding holds promise for sugar beets. Since several MC tests can be run in a day,



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greater numbers of prospective parents can be evaluated than in the usually time-consuming field tests. This could result in a tremendous savings in both time and space.

Short rotations/pest control

TRADITIONALLY, planting crops in rotations has provided the best way to manage populations of plant-parasitic nematodes. However, nonhost plants often are not as profitable as the main crop, so lengthy rotations reduce the economic efficiency of land use.

ARS nematologists Joseph M. Good and Bill B. Brodie, along with William S. Murphy, soil scientist with the Campbell Research Institute, West Chicago, Ill., studied the effects on the population dynamics of three types of plant-parasitic nematodes in both newly cleared and old land. Their studies, conducted at Tifton, Ga., involved combinations of five host plants and fallow in rotations of 1, 2, and 3 years.

The scientists found that long rotations for these less profitable nonhost plants could be shortened without affecting control of the plant-parasitic nematodes.

The main crop in these studies was tomato transplants; the rest of the cropping system consisted of milo,

crotalaria, millet, sudangrass, okra, and bare fallow.

Overall, tomato transplant yields were higher in newly cleared land than in old land and were not affected during the first 3 years by cropping systems on the new land. Effects from the cropping system were significant on old land, with highest yields when crotalaria was included. Lowest yields resulted where milo or bare fallow were included.

In no situation did the length of rotation show any distinguishable effect on tomato transplant yields. Individual crops seemed to be more critical. For example, a 1-year cropping system with crotalaria was as effective as 2 or 3 years of crotalaria in holding down nematode populations.

More ewes per ram

SHEEP BREEDERS may be wasting "ram power" by adhering to the current recommendation of running one ram with every 10 to 12 ewes when their estrus cycles are synchronized.

In recent tests on estrus-synchronized ewes, scientists showed that using one ram for every 20 ewes had no effect on the percentage of ewes bred or on the conception rate. In fact, these tests indicated that it may be possible to breed even more ewes per ram.

ARS physiologist Danny B. Laster and nutritionist Hudson A. Glimp at the U.S. Meat Animal Research Center, Clay Center, Nebr., studied the effect of using one ram to 8, 12, 16, or 20 ewes. A total of 200 ewes and 15 rams were involved in the study.

Rams were equipped with marking harnesses, and ewes were checked daily for markings. In all groups, 76 percent of the ewes were marked within 8 days after the end of progestagen treatment, with a conception rate of 84.5 percent. Progestinated pessaries were used to synchronize estrus.

The number of ewes per ram had no effect on the percentage of ewes lambing, the number of lambs born per ewe, or the average lambing date.

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other wildlife—if not handled or applied properly. Use all pesticides selectively and carefully.

